

FECUNDITY OF *ESOX LUCIUS* L. IN THE TISA RIVER

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Abstract

On the basis of collected material from 1980 to 1983 analysis of absolute and relative fecundity in relation to standard length, body mass and age, was done. In order to achieve this goal 73 mature female individuals were analysed. Also, correlation coefficient was estimated and very prominent individual variations were noticed. Absolute fecundity was from 9495 to 114 205 and relative fecundity from 21.73 to 57.96 number of eggs. The average of absolute fecundity were largest in the groups of individuals with the largest values of body mass, body length and in the oldest age groups. The average values of relative fecundity were the highest in the groups of individuals characterized with small body mass, body length and age. All these data were calculated using the expression: $\log F = a \log x + b$. Variations between real and calculated values of above mentioned parameters for absolute fecundity are directed to real values and for relative fecundity to calculated values.

Introduction

Ichthyofauna of Tisa river is not completely investigated concerning qualitative and quantitative aspects.

Some recent papers bring some light to this problem RISTIĆ (1977), GRGINČEVIĆ (1977), MALETIN et BUDAKOV (1983) et BUDAKOV et MALETIN (1984).

Also, some economically very important, as well as some rare species are not known very well.

The purpose of this paper is to expand some previous investigations of *Esox lucius* L. concerning fecundity of this species in the Tisa river.

Materials and Methods

Material for investigation was collected in the period between 1980—1983 in Tisa river (Tisa II). In the analysis 73 spawning female individuals were used (gonads were in the 4th maturity stage). Absolute and relative fecundity in relation to standard length, body mass and age were investigated. The relationship between absolute and relative fecundity and body length, body mass and age groups is presented using linear regression: $y = ax + b$. Also, correlation coefficients are calculated.

Variations of absolute and relative fecundity in relation to standard length, body mass and age were calculated according to the formula: $\log F = \log x + b$, F =fecundity, x =basic biological parameter which shows relation between these basic biological parameters and fecundity (method of the smallest square and logarithmic values).

Tab. 1. Absolute and relative fecundity of *Esox lucius* L. from Tisa depending on mass. Correlation

n	MASS group	M ± m	σ	ABSOLUTE	
				min—max	M ±
4	0—400	310,0 ± 22,73	45,46	9 495,00— 16 578,40	13 235,40 ±
22	401—800	578,63 ± 26,37	123,71	10 965,00— 38 190,00	22 548,35 ±
22	801—1200	920,00 ± 24,96	117,08	26 100,00— 64 337,00	37 536,24 ±
13	1201—1600	1505,00 ± 31,90	114,85	28 008,50— 74 855,00	54 072,50 ±
7	1601—2000	1825,71 ± 44,05	116,31	39 556,80—101 606,40	71 420,17 ±
2	2001—2400	2240,00 ± 40,00	56,56	90 037,50— 92 820,00	91 428,75 ±
2	2401—2800	2605,00 ± 195,58	275,77	79 337,80—110 120,80	94 729,30 ±
1	2801—3200	2900,00 ± —	—	—	114 205,00 ±

Tab. 2. Absolute and relative fecundity of *Esox lucius* L. from Tisa depending on standard lenght.

n	LENGHT group	M ± m	ABSOLUTE		
			min—max	σ	M ±
5	281—340	313,20 ± 8,42	9 495,00— 16 578,40	18,79	12 781,32 ±
18	341—300	352,22 ± 3,89	10 965,00— 38 190,00	16,50	23 810,56 ±
23	401—460	428,47 ± 3,62	19 598,40— 64 337,00	17,34	34 358,64 ±
15	461—520	492,66 ± 4,32	36 835,00— 74 865,00	16,74	51 897,55 ±
8	521—580	552,75 ± 6,11	39 556,80—101 606,40	17,23	73 747,33 ±
4	581—640	610,50 ± 11,52	79 337,80—114 205,00	23,04	99 120,90 ±

Tab. 3. Absolute and relative fecundity of *Esox lucius* L. from Tisa depending on age. Correlation

n	AGE GROUP	ABSOLUTE FECUNDITY			
		min—max	M ± m	σ	r
3	2+	28 131,60— 59 802,70	42 607,76 ± 9254,12	16 009,63	0,811 49
29	3+	9 495,00—110 120,80	42 810,15 ± 4675,58	21 152,58	
21	4+	10 965,00—105 212,80	39 941,85 ± 4311,29	19 745,74	
18	5+	13 890,80—101 606,40	40 151,25 ± 5937,55	24 462,74	
1	6+	—	79 337,80 ± —	—	
1	7+	—	114 205,00 ± —	—	

between fecundity and mass.

FECUNDITY			RELATIVE FECUNDITY			
m	σ	r	min—max	M \pm m	σ	r
1 712,24	342,48	0,670 69	30,62—48,94	42,60 \pm 4,08	8,17	0,092 10
1 376,19	6 454,36	0,693 14	26,10—53,04	37,16 \pm 1,57	7,39	0,219 41
2 405,72	11 282,85	0,746 31	29,44—57,96	39,82 \pm 1,80	8,48	0,408 76
3 853,76	13 873,57	-0,428 57	24,35—51,63	38,74 \pm 2,44	8,78	0,031 80
7 673,55	20 258,18	0,686 00	21,73—51,31	38,84 \pm 3,53	9,33	-0,139 95
1 395,40	1 967,52	-1,000 00	39,49—42,19	40,84 \pm 1,35	1,90	-1,000 00
15 437,49	21 766,86	1,000 00	32,93—39,32	36,12 \pm 3,20	4,52	1 000,00
—	—	—	—	39,38 \pm —	—	—

Correlation between fecundity and standard length

FECUNDITY			RELATIVE FECUNDITY			
m	σ	r	min—max	M \pm m	σ	r
1405,68	3 134,68	-0,170 29	30,62—48,94	39,30 \pm 4,58	10,22	-0,740 85
1612,55	6 837,24	0,725 11	24,34—53,04	38,77 \pm 1,70	7,24	0,114 57
2361,06	11 309,51	0,383 46	26,48—57,96	38,74 \pm 1,89	9,08	0,165 36
2494,16	11 413,27	0,535 51	25,05—51,63	38,88 \pm 2,26	8,74	-0,028 40
7048,55	19 876,92	-0,024 23	21,73—51,31	38,92 \pm 3,06	8,64	-0,272 39
8060,19	16 120,38	0,840 25	32,92—42,19	38,45 \pm 1,96	3,92	0,053 03

between fecundity and age groups

RELATIVE FECUNDITY			
min—max	M \pm m	σ	r
34,73—44,81	41,38 \pm 3,33	5,76	-0,548 02
24,35—53,46	38,95 \pm 1,51	8,14	
21,73—57,96	39,25 \pm 2,08	9,54	
28.93—51,31	37,97 \pm 1,81	7,49	
	32,92 \pm		
	39,38 \pm		

Results and Discussion

The individual absolute fecundity is very different in *Esox lucius* L. and other fish species.

Minimal values of absolute fecundity measuring 9495 were presented in the smallest body mass groups up to 400 g and maximal 114 205 were in the largest mass group from 2801 to 3200 g.

Increasing average values of mass groups was associated with an increase of average values of absolute fecundity which were ranged from 13 235.40 to 114 205 number of eggs.

In the smallest mass groups correlation is positive and average and in larger mass groups is absent. The highest correlation is estimated in mass group measuring 801—1200 g ($r=0.746\ 31$).

Relative fecundity is calculated from 21.73 to 57.96 numbers of eggs. The largest values of relative fecundity are 42.60 in the mass groups up to 400 g and smallest 36.12 in mass group from 2401 to 2800 g. The highest correlation coefficient $r=0.408\ 76$ was present in the mass group from 801 to 1200 g. In other group this parameter was positive, low or absent.

The smallest and the largest individuals as well as length values of absolute fecundity and average values of relative fecundity are present in the smallest and largest body length group with correlation coefficient $r=0.840\ 25$ which is positive and high or in relative fecundity positive and low ($r=0.165\ 36$) in body length group 401—460 mm.

Absolute fecundity of *Esox lucius* L. of age 2+ and 3+ has some values (42 607.76—42 810.15 number of eggs, in the group 4+ this value is decreased, and finally in the age group 7+ value absolute fecundity is increased with a positive and high correlation coefficient (0.811 49).

In the relative fecundity correlation coefficient is negative and average (0.548 02).

Variations between real and calculated values for absolute fecundity in relation to body mass, body length and age groups (directed to the real values) are presented in the table 4.

The most prominent variations are presented in the mass groups 2001/2400 g directed to real values and measuring 5812.04 or 6.35%.

Regarding variations of relative fecundity which are directed to real values and they are smaller than calculated, making differences in all mass groups directed to calculated values.

Variations between real and calculated values concerning absolute fecundity depending on body length groups directed to real values are largest in the body length group 521—580 mm accounting for 3545.05 or 18.36%.

Variations of relative fecundity directed to real values are not detected. Calculated values are much higher.

Comparing variations between real and calculated values for absolute and relative fecundity, it was evident that they were higher in individuals labelled as 7+ accounting for 47.50 or 10.12% and directed to real values.

In single mass, body length or age group minimal values of absolute and relative fecundity could be ten times smaller than maximal values (SPANOVSKAJA i SOLONINOVA 1983).

Our results confirm prominent individual variations. Similar results were reported by TARNAVSKIJ (1965), PERVOZVANSKIJ (1984), SAZANOVA (1979) i MOHOV (1980).

The medium values of absolute fecundity increased with increasing of average

Tab. 4. Real and calculated values of absolute and relative fecundity of *Esox lucius* L. from Tisa depending of mass, length and age groups

		n	X mass	X ab. fec.	cal. ab. fec.	diff.	%	X rel. f.	cal. r. f.	diff.	%
Mass group	0—400	4	310,00	13 235,40	12 815,15	430,24	3,17	42,60	52,00	—9,40	22,06
	401—800	22	578,53	22 548,35	23 263,95	—715,60	3,17	37,16	51,84	—14,68	39,50
	801—120	23	920,00	37 536,24	36 183,08	1 352,15	3,60	39,82	51,94	—12,12	30,43
	1201—1600	12	1505,00	54 072,50	57 533,22	—3 460,72	6,40	38,74	51,87	—13,13	33,89
	1601—2000	7	1825,71	71 420,17	70 184,07	1 236,09	1,73	38,84	51,87	—13,03	33,54
	2001—2400	2	2240,00	91 428,75	85 616,70	5 812,04	6,35	40,84	51,97	—11,13	27,25
	2401—2800	2	2605,00	94 729,30	97 747,37	3 018,07	3,18	36,12	51,77	—15,65	43,32
	2801—3200	1	2900,00	114 205,00	109 159,26	—5 045,73	4,41	39,38	51,90	—12,52	31,79
Length group	281—340	5	313,20	12 781,32	14 095,97	—1 314,65	10,28	39,30	42,76	—3,46	8,80
	341—400	18	352,22	23 810,56	19 606,25	1 204,30	17,65	38,77	42,80	—4,03	10,39
	401—460	23	428,47	34 358,64	35 508,61	—1 149,97	3,34	38,74	42,88	—4,14	10,68
	461—520	15	492,66	51 897,55	52 758,58	—861,03	1,63	38,88	42,94	—4,06	10,44
	521—580	8	552,75	73 747,33	60 202,27	3 545,05	18,36	38,92	42,98	—4,06	10,43
	581—640	4	610,50	99 120,90	95 550,33	3 570,56	3,60	38,45	43,02	—4,57	11,88
Age group	2+	3		42 607,76	32 889,55	9 718,20	29,54	41,38	40,59	0,78	1,92
	3+	29		42 810,15	43 063,88	—253,73	0,58	38,95	39,00	—0,05	0,12
	4+	21		39 941,85	52 920,75	—12 978,90	24,52	39,25	37,83	1,41	3,72
	5+	18		40 151,25	61 037,45	—20 886,20	34,21	37,97	37,04	0,92	2,48
	6+	1		79 337,80	69 291,69	10 046,10	14,49	32,92	36,35	—3,43	9,43
	7+	1		114 205,00	77 424,85	36 780,14	47,50	39,38	35,75	3,62	10,12

values of body mass, body length and age, and were the highest in the largest body mass, body length and the oldest groups.

Similar regularity was presented by TARNAVSKIJ (1965), TERLECKI (1973), BANĖNENENE (1978) and KORVIN—KOSSAKOWSKI (1976) reports that increasing of absolute fecundity with increasing of body mass is linear, but with body length, change is parabolic line. Age does not affect absolute fecundity, but calculated values are regular.

Relative fecundity compared with changes in the body mass, body length and age of *Esox lucius* L. does not show regularity. According to the same author, with an increase of the egg diameter, relative fecundity also becomes higher.

Minimal and maximal values of relative fecundity *Esox lucius* L. from the Tisa river are much higher than values reported by SOLOV'EVA (1965), TERLECKI (1973), BANĖNENENE (1978) and al.

In *Esox lucius* L. a real, relative fecundity has a tendency of increasing from northern to southern area.

Conclusions

1. Prominent individual variations of body mass, body length and age were noticed.

2. The medium values of absolute fecundity increased with an increase of average values of body mass, body length and age, and are the highest in the largest body mass, body length and age groups.

3. Relative fecundity is larger in the smaller body mass, body length and age groups.

4. Variations between real and calculated values for absolute fecundity depending on body mass, body length and age groups are directed to real values, but for relative fecundity they are directed to calculated values.

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A Tisza csukáinak termékenysége

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Tartományi Természetvédelmi Hivatal, Újvidék

Kivonat

A szerző az 1980—83-ban gyűjtött 73 ivarérett ikráshal abszolút és relatív termékenységének vizsgálatát a testhossz, testtömeg és életkor függvényében, korrelációs koefficiensszámítással végezte. Megállapítást nyert, hogy az abszolút termékenység 9495—114 205, a relatív 21,73—57,96 ikrát tesz ki. A $\log F = a \log x + b$ képlettel számított abszolút termékenység átlagértéke a legöregebb és legnagyobb testtömegű és testhosszú egyedeknél a legnagyobb, a relatív pedig a legfiatalabb és legkisebb példányok esetében. A vizsgált paraméterek tényleges és számítással kapott értéke közötti eltérés az abszolút termékenység esetében a tényleges, a relatívénál a számított értékek felé hajlik.

Плодовитость щуки *Esox Lucius* L. в р. Тиса

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Резюме

На основании материала, полученного в период с 1980 по 1983 г.г. выполнен анализ абсолютной и относительной плодовитости в отношении к стандартной длине, весу и росту при осмотре половозрелых самок. Сделаны также расчеты коэффициентов корреляций. При этом установлены большие индивидуальные вариации. Абсолютная плодовитость наблюдалась в пределах от 9495,00 до 114 205, а относительная от 21,73 до 57,96 икринок. Средние значения абсолютной плодовитости самые большие в группах с самым большим весом, длиной и возрастом, а относительная плодовитость — в группах, характеризующихся небольшим весом, длиной и младшим возрастом. Расчет выполнен на основании формулы: $\log F = a \log x + b$.

Отступления между фактическими и рассчитанными значениями указанных параметров для абсолютной плодовитости относятся в пользу фактических значений, а для относительной плодовитости — в пользу расчетных.

Plodnost štuke *Esox lucius* L. u Tisi

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Pokrajinski zavod za zaštitu prirode u Novom Sadu

Izvod

Na osnovu materijala sakupljenog u periodu od 1980. do 1983. godine analizirana je apsolutna i relativna plodnost u odnosu na standardnu dužinu, masu tela i uzrast, pregledom 73 polno zrelih ženki. Izračunati su i koeficijenti korelacije. Konstatovana su velika individualna variranja. Apsolutna plodnost kretala se od 9495,00 do 114 205 a relativna od 21,73 do 57,96 komada jaja. Srednje vrednosti apsolutne plodnosti su najveće kod najvećih masenih i dužinskih i najstarijih uzrasnih grupa, a relativna plodnost kod manjih masenih, dužinskih i mlađih zurasnih grupa, računata formulom: $\log F = a \log x + b$. Odstupanje između stvarnih i izračunatih vrednosti navedenih parametara za apsolutnu plodnost je u korist stvarnih vrednosti, a za relativnu plodnost u korist izračunatih.